7th Meeting of representatives of laboratories contributing to TAI, 2006/09/12+13

Towards a good pivot and crossover site

- A follow-up to the Study Group report
- Recent calibration exercises

Current Link Configuration

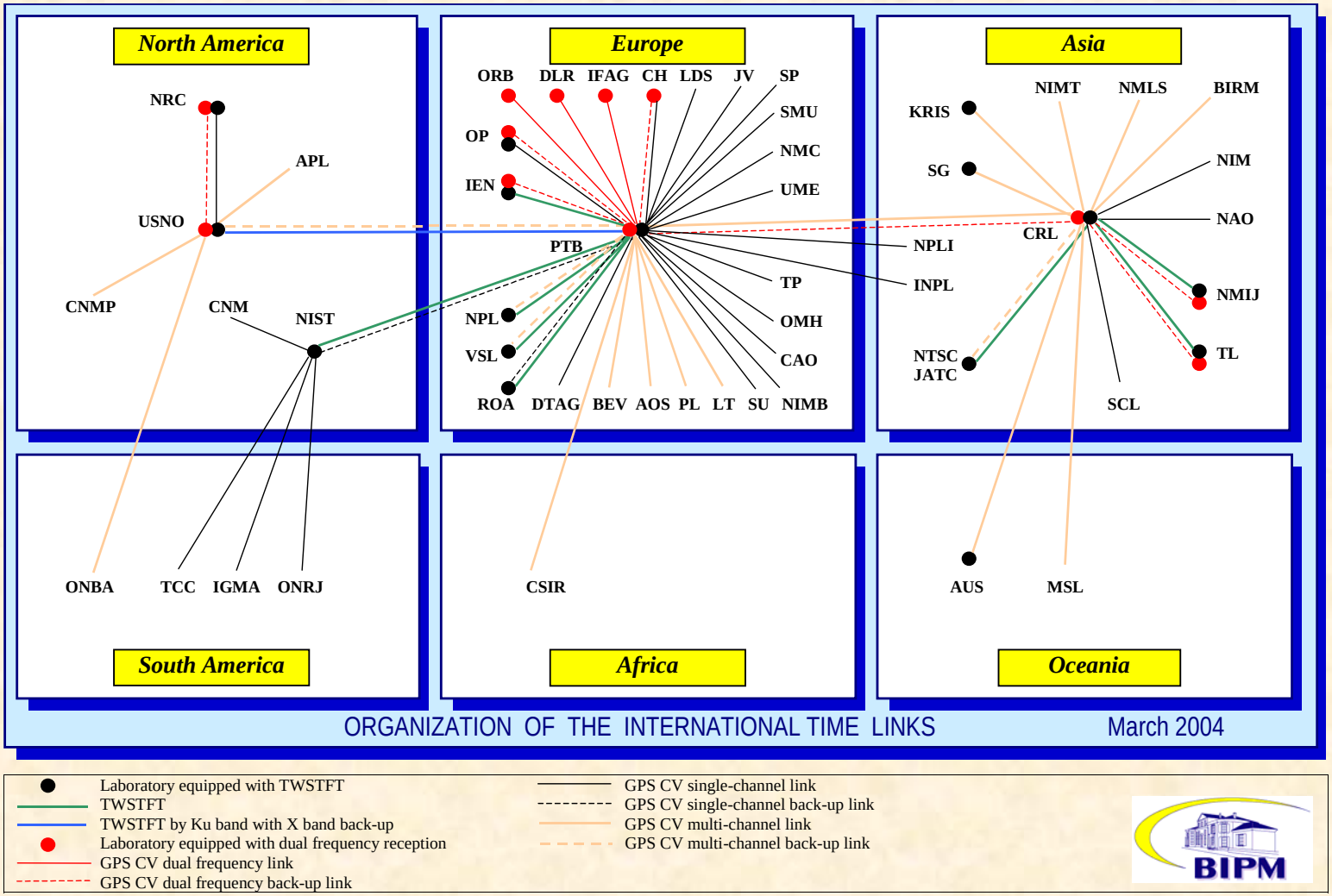


Fig. 2 The TAI/Circular T time links

Two Definitions

- Pivot Site
  - A site linked to at least two other sites for TAI-Generation
- Crossover Site
  - A pivot site for which at least two of the links use different time transfer systems

Ideal Crossover Site

- At least two independent TWSTFT and >= 2 independent GPS systems

TWSTFT Ku band

- one operational station, one station on loan from Time Tech (dismantled)
- spare up and down converter, LNA, HPA (in part new, in part re-use of DTAG)
- two SATRE modems, one single channel (# 037) one triple channel (# 280)
- operational station for link to Asia provided and installed by NICT

TWSTFT X band (for link to USNO)

- Operational station (SATRE modem # 076) with spare parts

- To be done:
- automatic alert when operations are disturbed
- Provision of X-Band data without outliers

Ideal Crossover Site

- At least two independent TWSTFT and >= 2 independent GPS systems

GPS receivers

C/A code multichannel TTS-2 (2 SC rec. as back up)

TTS-3 (Javad based) providing L1C, L3P, GLONASS

Septentrio PolaRx-2 and Ashtech Z12-T,

data processing by BKG

To be done:

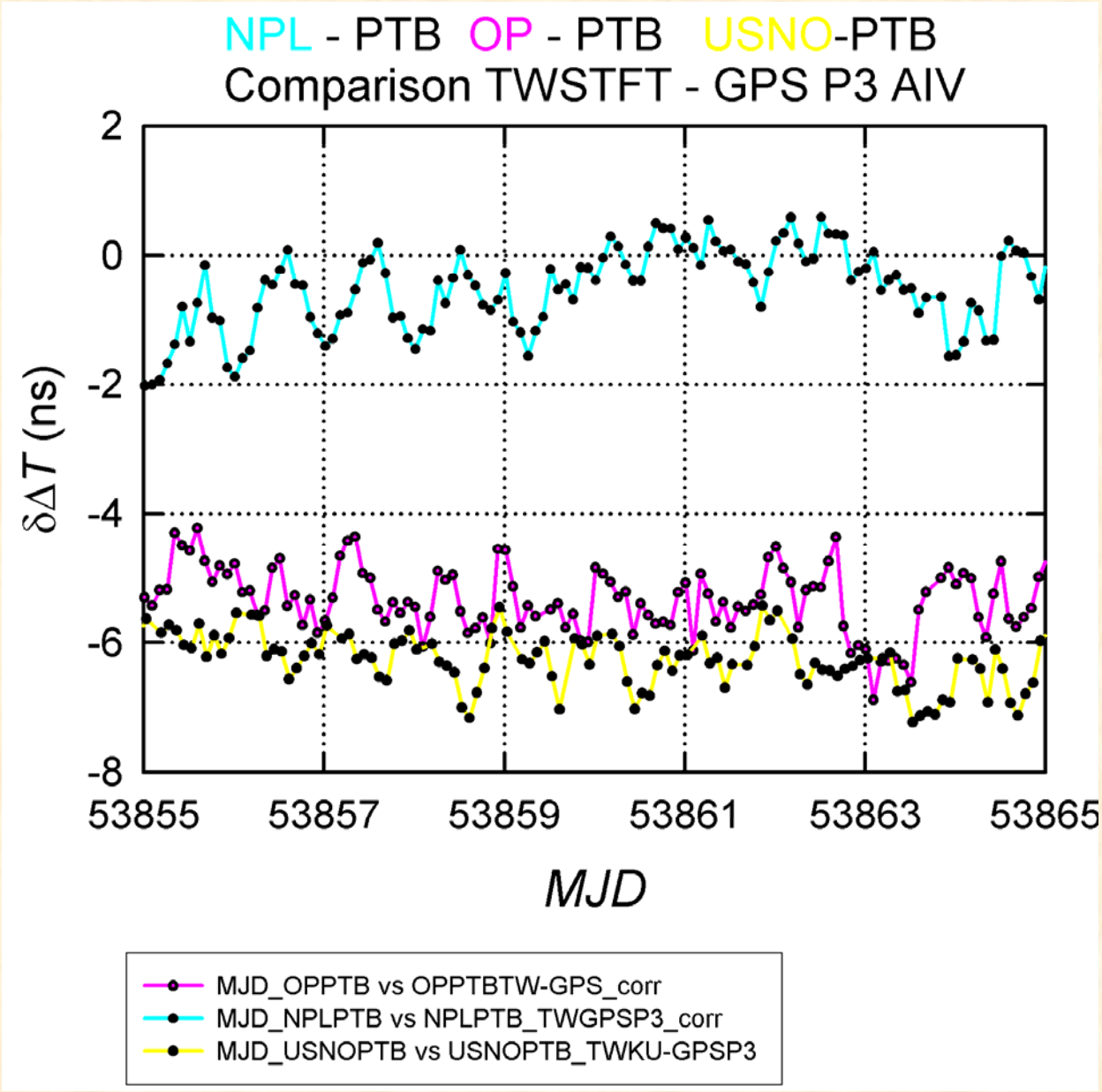
- automatic alert when operations are disturbed (as far as possible)

Ideal Crossover Site (cont.)

Ideal Crossover Site (cont.)

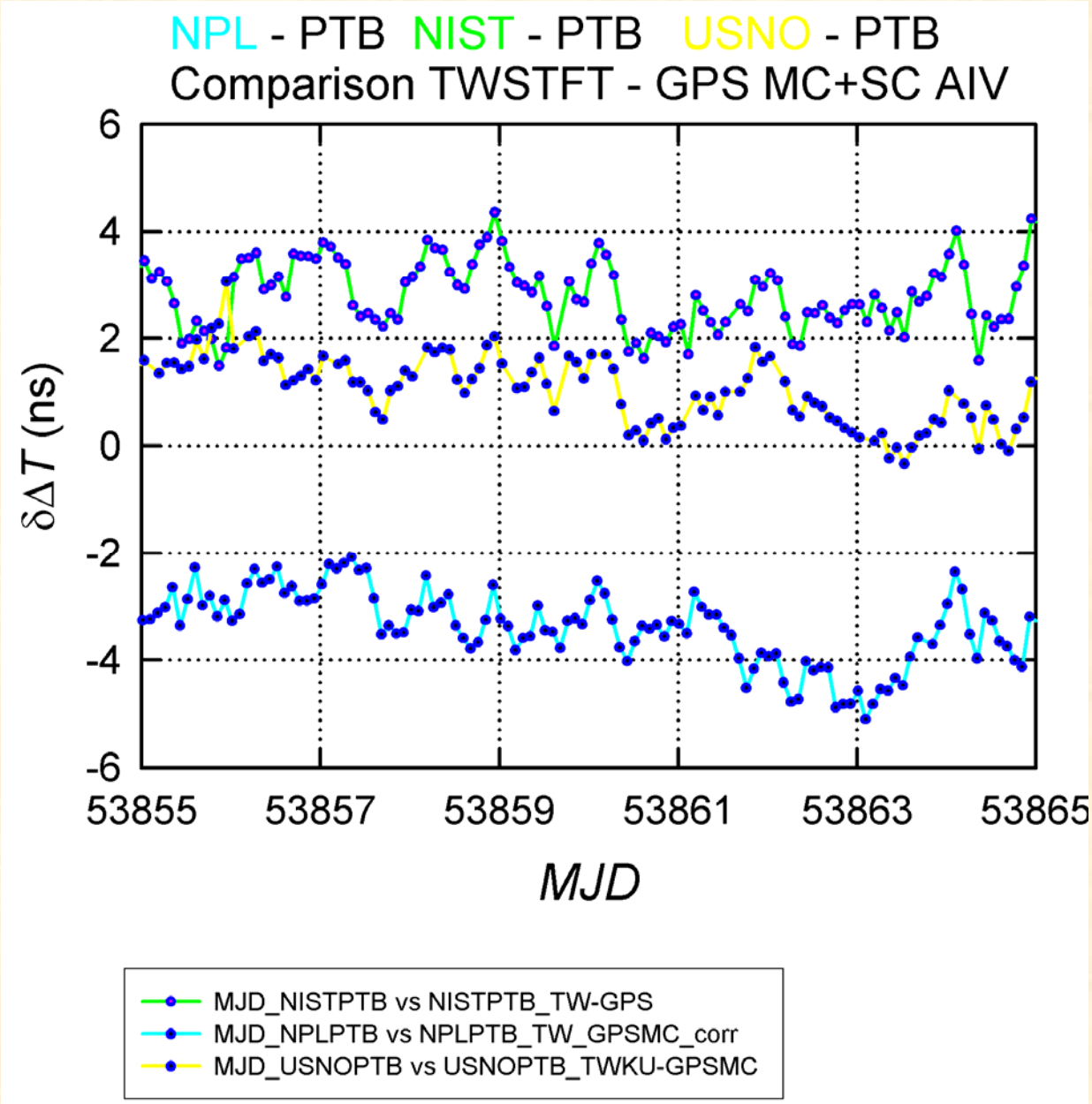
- Environmental control:
  - Clock room, equipment room:
  - Temperature controlled, mean 23.5 °C, RMS 0.2 °C peak-to peak about 0.6°C during the year (excl. few days when coolant flow blocked)
  - Rel. Humidity limited between 40% and 60%
  - Internal cables “state-of the-art” in 1965, 1990, 2003

Time Links Comparisons (BIPM LkC / Jiang)



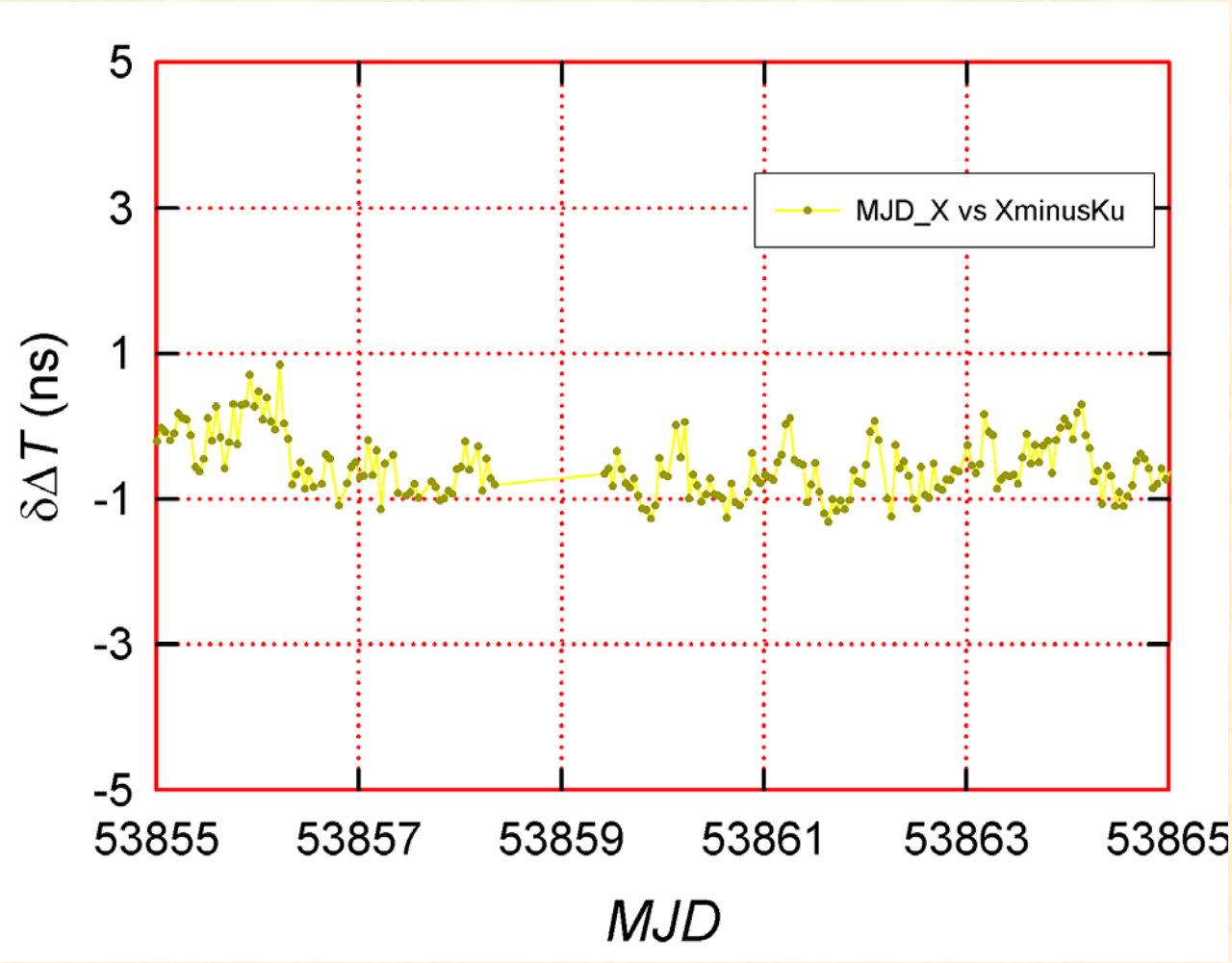
TWSTFT Ku minus GPS P3

Time Links Comparisons (BIPM LkC / Jiang)



TWSTFT Ku minus GPS C/A SC MC

Time Links Comparisons (BIPM LkC / Jiang)



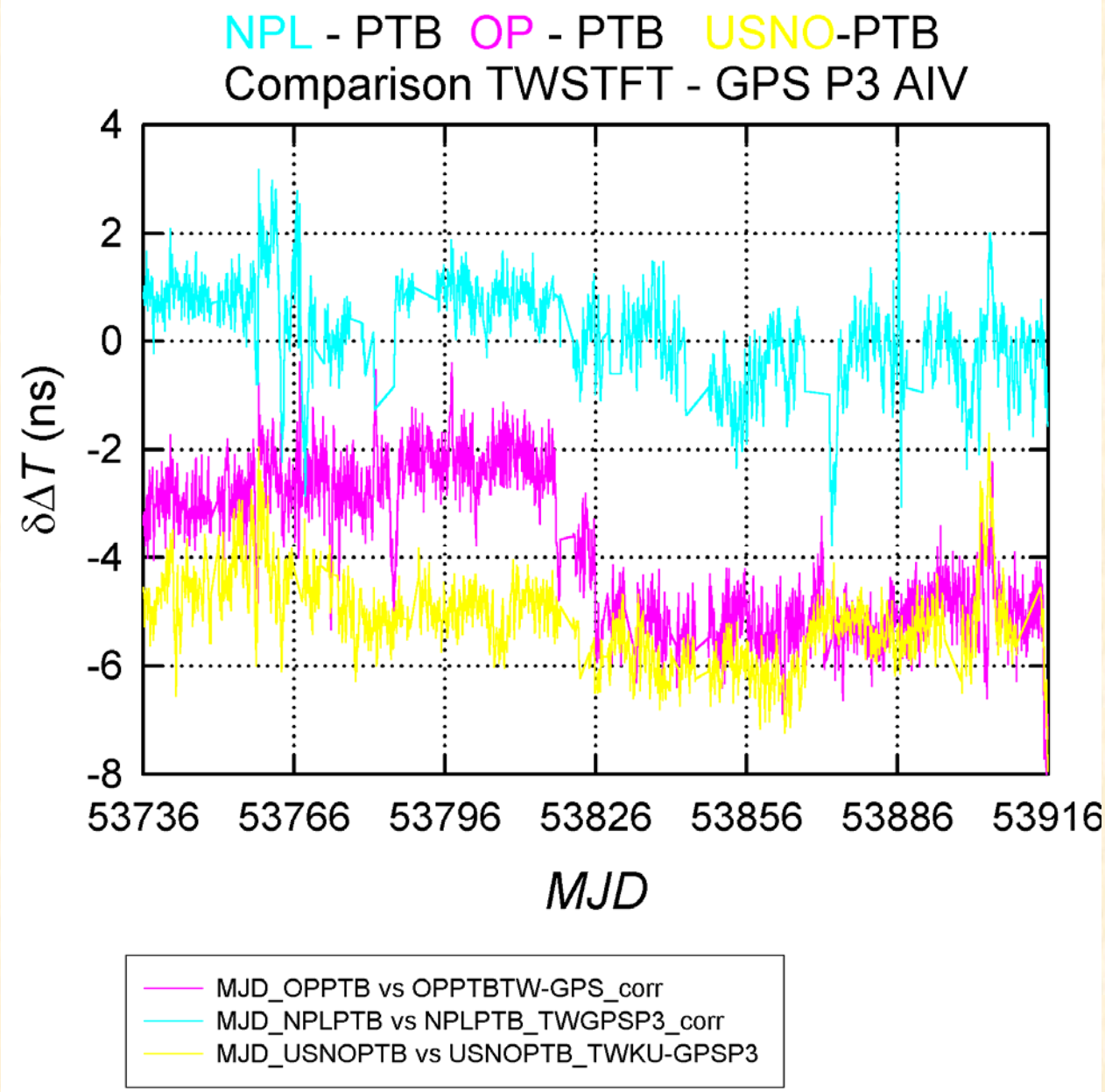
TWSTFT Ku Minus X

USNO-PTB

Ideal Crossover Site (cont.)

- Monitoring of key components
  - Continuously monitored electronically
    - under development but far from perfect right now
  - Human oversight and human hindsight
    - Status today:
    - Check of time transfer data weekly (Rec1 – Rec2)
    - Check of equipment status on working days
    - Check of clock performance on working days
    - Long term link stability analysis based on BIPM data, available at ftp.tai.org/TimeLink/LkC

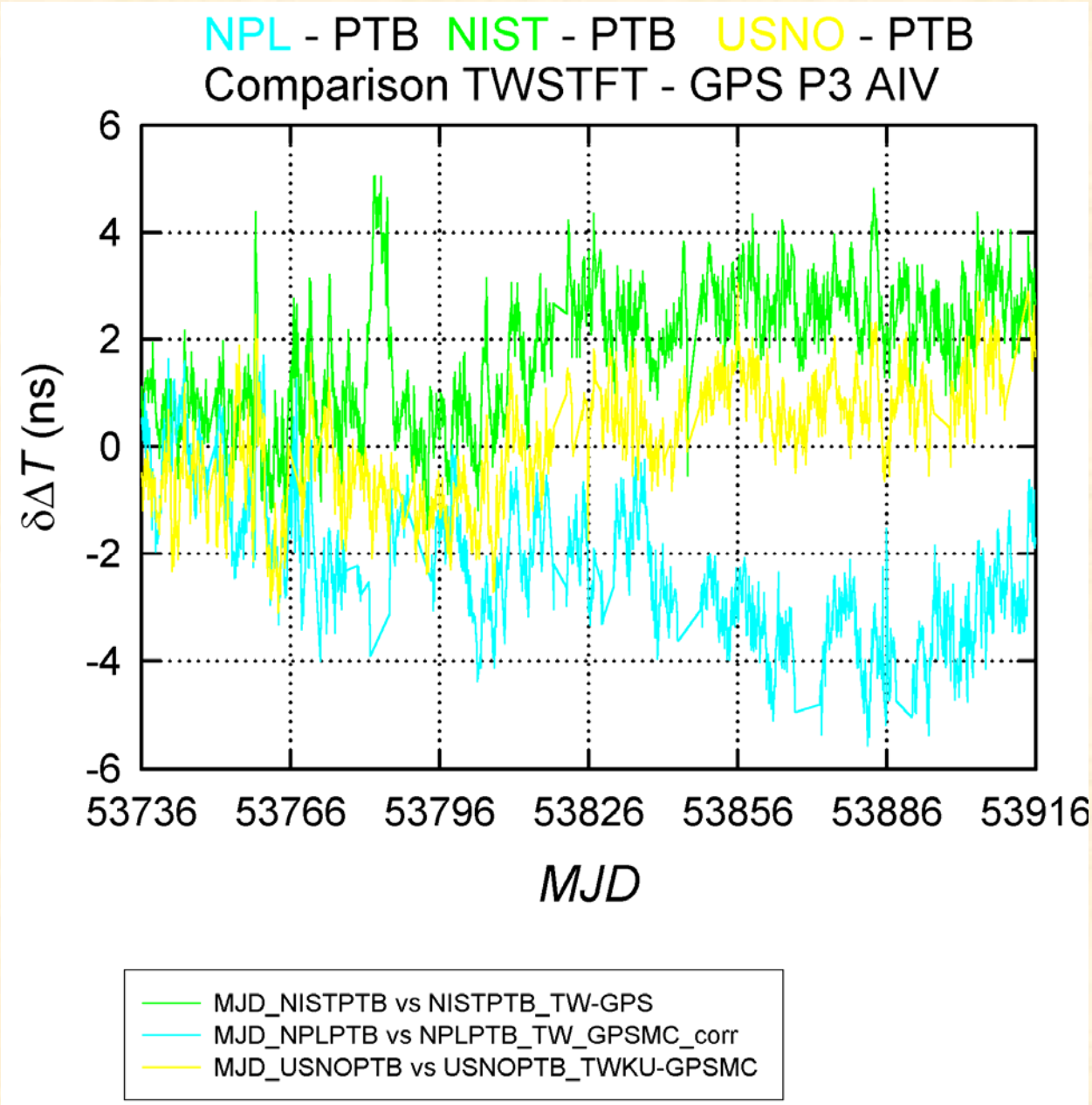
Time Links Comparisons (BIPM LkC / Jiang)



TWSTFT Ku minus GPS P3

Jan-Jun 2006

Time Links Comparisons (BIPM LkC / Jiang)



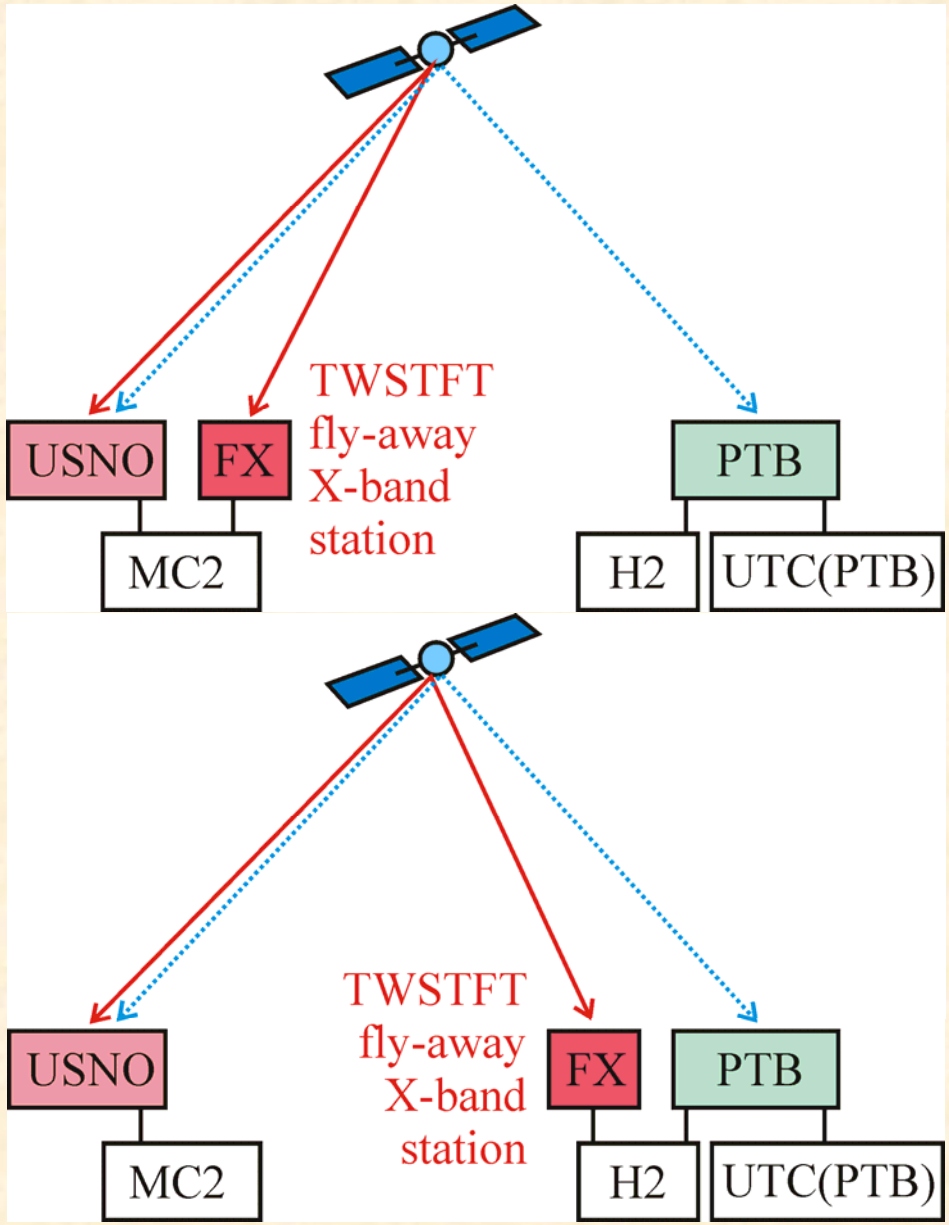
TWSTFT Ku minus GPS C/A SC MC

Jan – June 2006

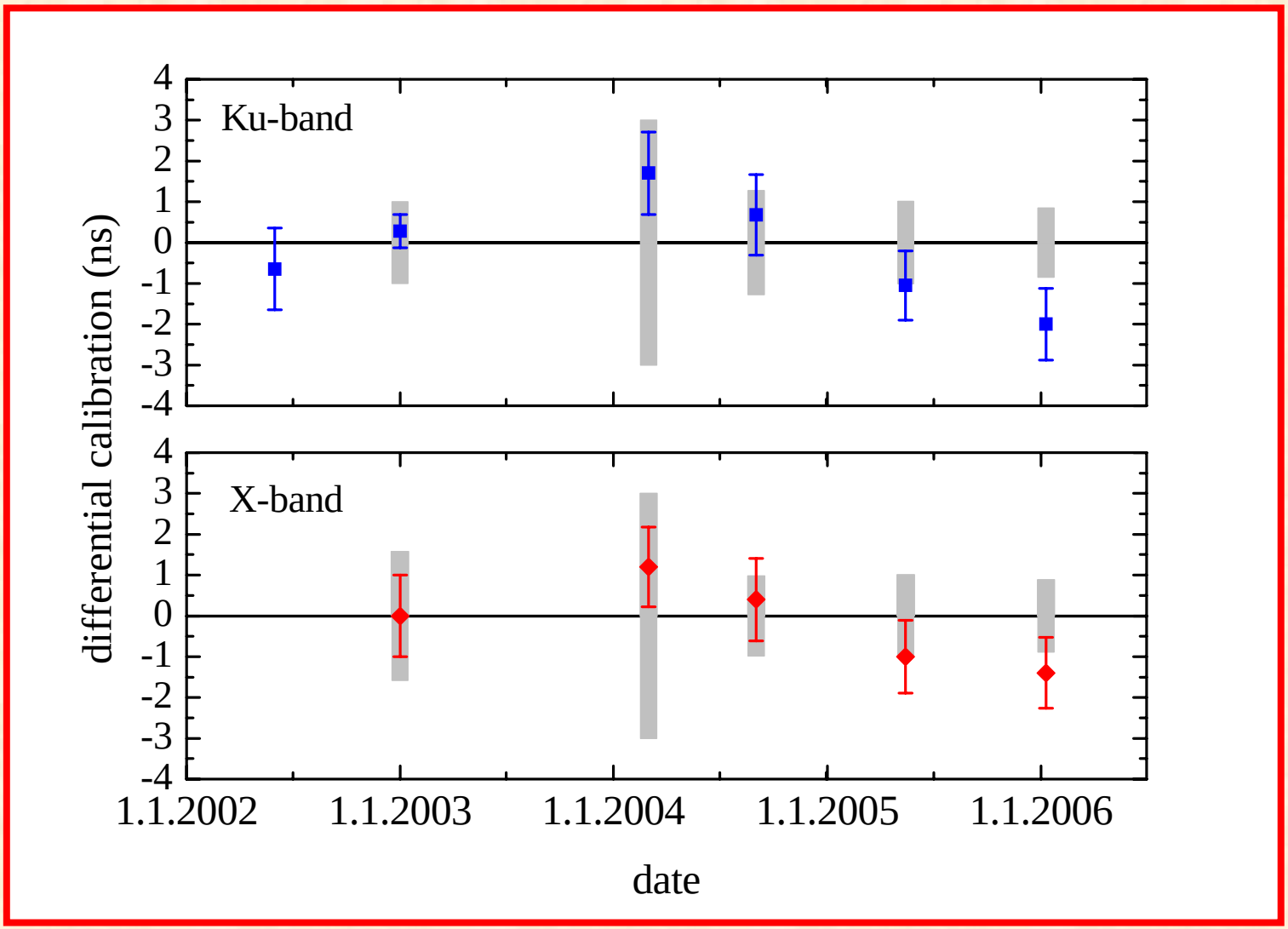
USNO Calibration of Time Link

7 calibration exercises conducted by USNO:

June 2002
January 2003
July 2003
March 2004
September 2004
May 2005
January 2006



Results of repeated calibrations



Calibration of Ku-band links

Travelling station provided by Joanneum Research under contract

July 2004: PTB – OP – NPL – VSL – PTB

Oct/Nov 2005: PTB – SP – VSL – NPL – OP – IT – PTB

June 2006: TUG – PTB – METAS - TUG

Acknowledgements

- USNO A. McKinley, L. Breakiron, A. Smith, E. Newman, D. Matsakis
- NICT H. Maeno, M. Fujieda
- BIPM Z.Jiang
- BKG U. Hessels
- Joanneum Research Bernd Blanzano
- PTBD. Piester, J. Becker, T. Polewka